U.S. Department of the Interior
U.S. Geological Survey

# MINERAL COMMODITY SUMMARIES 2007

Abrasives
Aluminum
Antimony
Arsenic
Asbestos
Barite
Bauxite
Beryllium
Bismuth
Boron
Bromine
Cadmium
Cement
Cesium
Chromium
Clays
Cobalt
Columbium
Copper
Diamond
Diatomite
Feldspar
Fluorspar
Gallium
Garnet
Gemstones
Germanium
Gold
Graphite
Gypsum
Hafnium
Helium
Indium
Iodine
Iron Ore
Iron and Steel
Kyanite
Lead
Lime
Lithium
Magnesium
Manganese
Mercury
Mica
Molybdenum
Nickel
Nitrogen
Peat
Perlite
Phosphate Rock
Platinum
Potash
Pumice
Quartz Crystal
Rare Earths
Rhenium
Rubidium
Salt
Sand and Gravel
Scandium
Selenium
Silicon
Silver
Soda Ash
Sodium Sulfate
Stone
Strontium
Sulfur
Talc
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Vanadium
Vermiculite
Yttrium
Zinc
Zirconium

USGS
*science for a changing world*

# CONTENTS

# INSTANT INFORMATION

Information about the U.S. Geological Survey, its programs, staff, and products is available from the Internet at URL <http://www.usgs.gov> or by contacting the Earth Science Information Center at 1-888-ASK-USGS (1-888-275-8747).

This publication has been prepared by the Minerals Information Team. Information about the Team and its products is available from the Internet at URL <http://minerals.usgs.gov/minerals> or by writing to Chief Scientist, Minerals Information Team, 988 National Center, Reston, VA 20192.

# KEY PUBLICATIONS

*Minerals Yearbook*—These annual publications review the mineral industries of the United States and foreign countries. They contain statistical data on minerals and materials and include information on economic and technical trends and developments. The three volumes that make up the Minerals Yearbook are Volume I, Metals and Minerals; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

*Mineral Commodity Summaries*—Published on an annual basis, this report is the earliest Government publication to furnish estimates covering nonfuel mineral industry data. Data sheets contain information on the domestic industry structure, Government programs, tariffs, and 5-year salient statistics for more than 90 individual minerals and materials.

*Mineral Industry Surveys*—These periodic statistical and economic reports are designed to provide timely statistical data on production, distribution, stocks, and consumption of significant mineral commodities. The surveys are issued monthly, quarterly, or at other regular intervals.

*Metal Industry Indicators*—This monthly publication analyzes and forecasts the economic health of three metal industries (primary metals, steel, and copper) using leading and coincident indexes.

*Nonmetallic Mineral Products Industry Indexes*—This monthly publication analyzes the leading and coincident indexes for the nonmetallic mineral products industry (NAICS 327).

*Materials Flow Studies*—These publications describe the flow of materials from source to ultimate disposition to help better understand the economy, manage the use of natural resources, and protect the environment.

*Recycling Reports*—These materials flow studies illustrate the recycling of metal commodities and identify recycling trends.

*Historical Statistics for Mineral and Material Commodities in the United States (Data Series 140)*—This report provides a compilation of statistics on production, trade, and use of more than 80 mineral commodities during the past 100 years.

# WHERE TO OBTAIN PUBLICATIONS

- *Mineral Commodity Summaries* and the *Minerals Yearbook* are sold by the U.S. Government Printing Office, Superintendent of Documents. Orders are accepted over the Internet at URL <http://bookstore.gpo.gov>, by telephone toll free (866) 512-1800; Washington, DC area (202) 512-1800, by fax (202) 512-2250, or through the mail (Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954).

- All current and many past publications are available in PDF format (and some are available in XLS format) through URL <http://minerals.usgs.gov/minerals>.

# INTRODUCTION

Each chapter of the 2007 edition of the U.S. Geological Survey (USGS) Mineral Commodity Summaries (MCS) includes information on events, trends, and issues for each mineral commodity as well as discussions and tabular presentations on domestic industry structure, Government programs, tariffs, 5-year salient statistics, and world production and resources. The MCS is the earliest comprehensive source of 2006 mineral production data for the world. More than 90 individual minerals and materials are covered by 2-page synopses.

The principal sources for the reserves and reserve base information provided for most mineral commodities are trade journals and Government reports from Australia, Brazil, Canada, Chile, China, Germany, India, Japan, Mexico, Morocco, Peru, South Africa, the United Kingdom, and the United States.

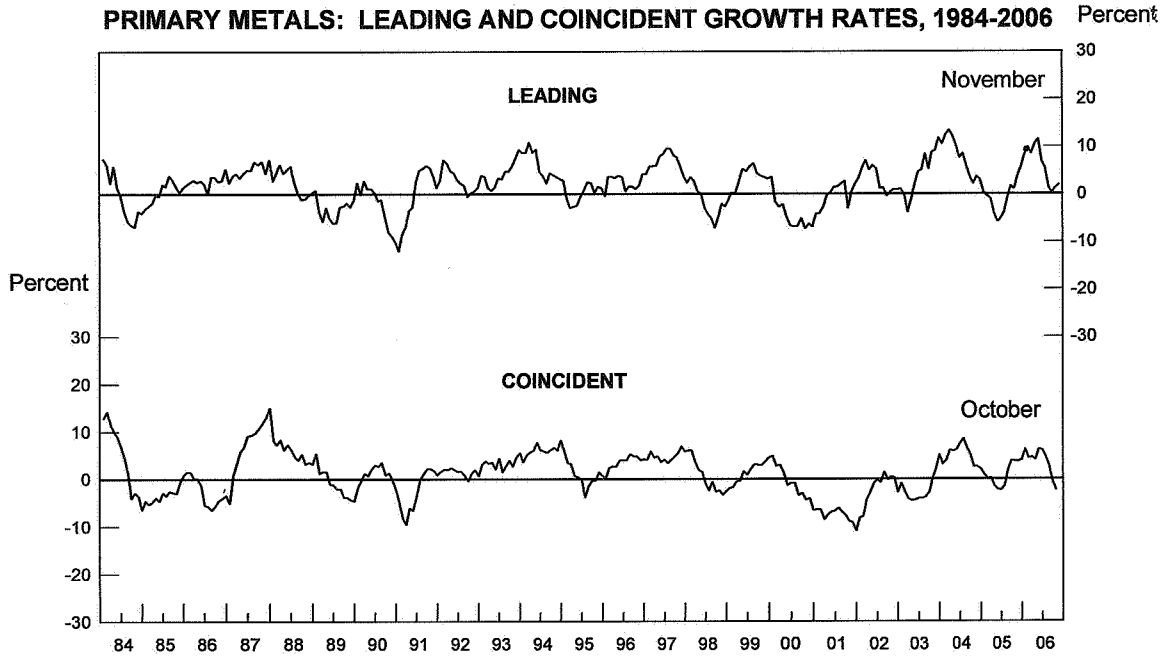
The "Significant Events, Trends, and Issues" section is an overview of domestic and international events affecting minerals that are important to the U.S. economy. Of particular note in 2006 was the increase in value of about 18% compared with that of 2005 for nonfuel minerals and mineral materials mined in the United States. Asian economies grew rapidly (China's increase in real gross domestic product was estimated at about 10.5% and India's was about 8.5%) and played increasingly important roles as both producers and consumers of minerals and materials. Many mineral-producing companies reported significant profits, owing to high prices for some metals as well as increased production for most nonfuel mineral commodities. Worldwide expenditures for exploration for nonferrous metals were expected to surpass $7 billion, a record high and almost 40% over that of last year. Primary areas for exploration were Latin America, followed by Canada and Africa. Exploration for gold, base metals, diamond, platinum-group metals, silver, molybdenum, cobalt, mineral sands, and some industrial minerals other than diamond all reached record levels in 2006.

Abbreviations and units of measure, and definitions of selected terms used in the report, are in Appendix A and Appendix B, respectively. A resource/reserve classification for minerals, based on USGS Circular 831 (published with the U.S. Bureau of Mines) is Appendix C, and a directory of USGS minerals information country specialists and their responsibilities is Appendix D.

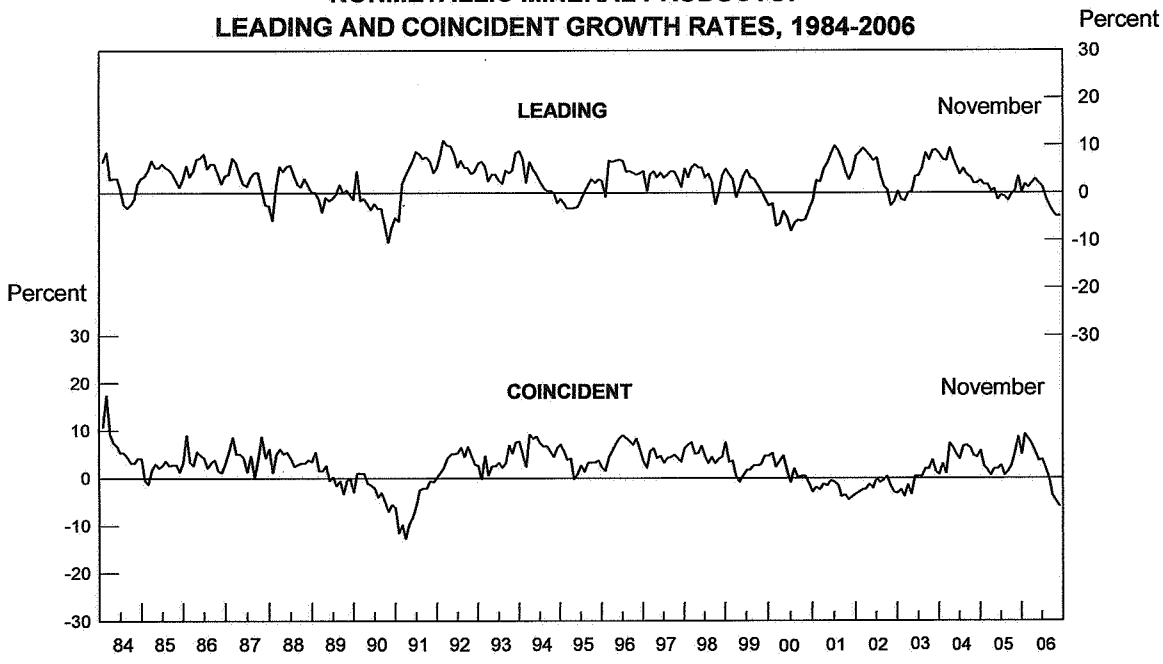
The USGS continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the MCS 2007 are welcomed.

# GROWTH RATES OF LEADING AND COINCIDENT INDEXES FOR MINERAL PRODUCTS

**PRIMARY METALS: LEADING AND COINCIDENT GROWTH RATES, 1984-2006**




**NONMETALLIC MINERAL PRODUCTS: LEADING AND COINCIDENT GROWTH RATES, 1984-2006**

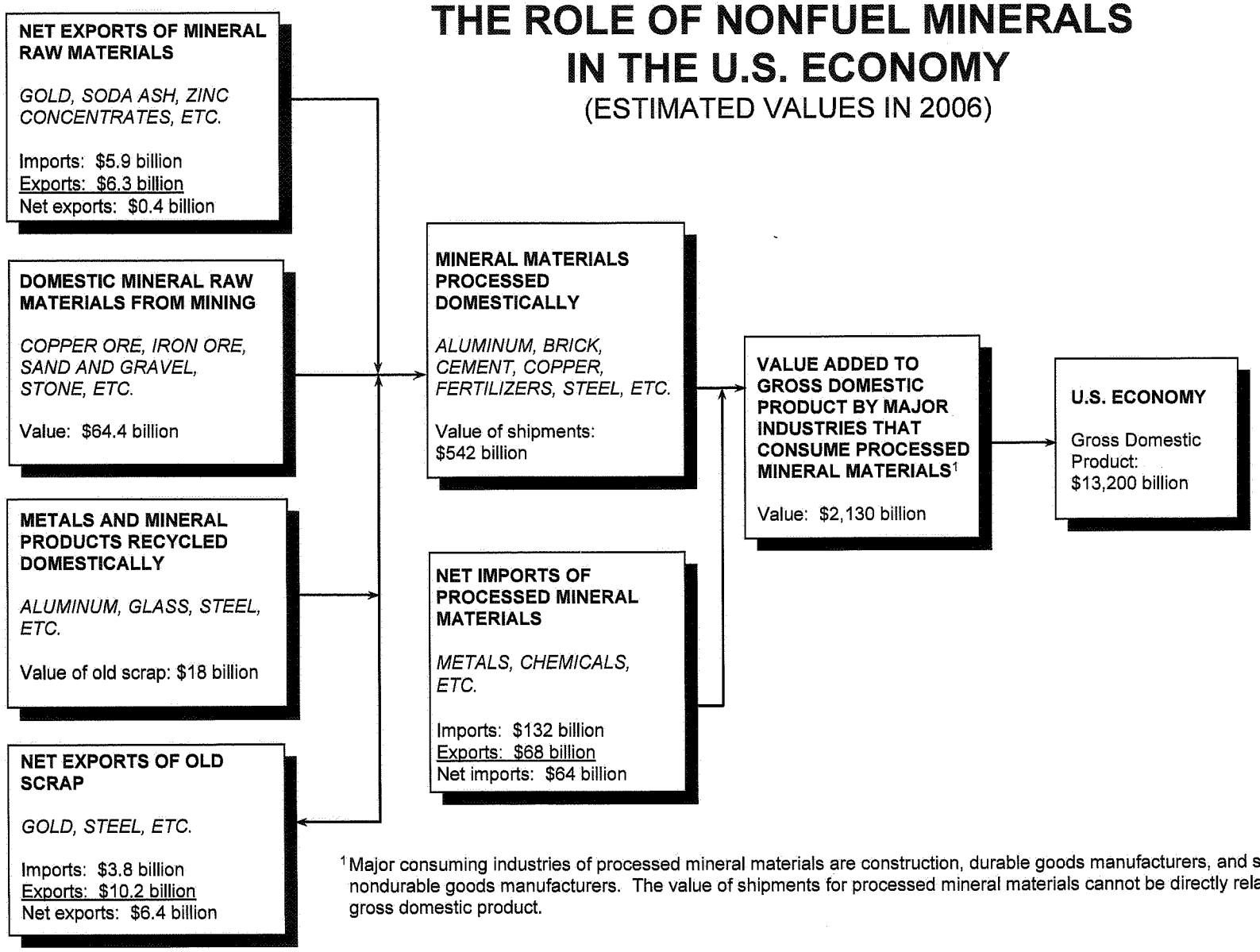



The leading indexes historically give signals several months in advance of major changes in the corresponding coincident index, which measures current industry activity. The growth rates, which can be viewed as trends, are expressed as compound annual rates based on the ratio of the current month's index to its average level during the preceding 12 months.

Sources: U.S. Geological Survey, *Metal Industry Indicators* and *Nonmetallic Mineral Products Industry Indexes.*

# THE ROLE OF NONFUEL MINERALS IN THE U.S. ECONOMY

(ESTIMATED VALUES IN 2006)




[1] Major consuming industries of processed mineral materials are construction, durable goods manufacturers, and some nondurable goods manufacturers. The value of shipments for processed mineral materials cannot be directly related to gross domestic product.

Sources: U.S. Geological Survey and U.S. Department of Commerce.

# THORIUM

(Data in metric tons of thorium oxide ($ThO_2$) equivalent unless otherwise noted)

**Domestic Production and Use:** The primary source of the world's thorium is the rare-earth and thorium phosphate mineral monazite. In the United States, thorium has been a byproduct of refining monazite for its rare-earth content. Monazite itself is recovered as a byproduct of processing heavy-mineral sands for titanium and zirconium minerals. In 2006, monazite was not recovered domestically as a salable product. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials previously shipped from U.S. Government stockpiles. About eight companies processed or fabricated various forms of thorium for nonenergy uses, such as high-temperature ceramics, catalysts, and welding electrodes. Thorium's use in most products has decreased because of its naturally occurring radioactivity. The value of thorium alloys, compounds, and metal used by the domestic industry was estimated to have increased to about $1.1 million.

| Salient Statistics—United States: | 2002 | 2003 | 2004 | 2005 | 2006[e] |
|---|---|---|---|---|---|
| Production, refinery[1] | — | — | — | — | — |
| Imports for consumption: | | | | | |
| Thorium ore and concentrates (monazite), gross weight | — | — | — | — | — |
| Thorium ore and concentrates (monazite), $ThO_2$ content | — | — | — | — | — |
| Thorium compounds (oxide, nitrate, etc.), gross weight | 0.65 | 4.10 | 5.32 | 4.93 | 38.0 |
| Thorium compounds (oxide, nitrate, etc.), $ThO_2$ content | 0.48 | 3.03 | 3.94 | 3.65 | 28.0 |
| Exports: | | | | | |
| Thorium ore and concentrates (monazite), gross weight | — | — | — | — | — |
| Thorium ore and concentrates (monazite), $ThO_2$ content | — | — | — | — | — |
| Thorium compounds (oxide, nitrate, etc.), gross weight | 0.88 | 0.59 | 0.73 | 0.74 | 1.00 |
| Thorium compounds (oxide, nitrate, etc.), $ThO_2$ content | 0.65 | 0.44 | 0.54 | 0.55 | 0.74 |
| Shipments from Government stockpile excesses ($ThNO_3$) | — | — | — | — | — |
| Consumption: | | | | | |
| Reported, ($ThO_2$ content[e]) | NA | NA | NA | NA | NA |
| Apparent | NA | NA | NA | NA | NA |
| Price, yearend, dollars per kilogram: | | | | | |
| Nitrate, welding-grade[2] | 5.46 | 5.46 | 5.46 | 5.46 | 5.46 |
| Nitrate, mantle-grade[3] | 27.00 | 27.00 | 27.00 | 27.00 | 27.00 |
| Oxide, yearend: | | | | | |
| 99.9% purity[4] | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 |
| 99.99% purity[4] | 107.25 | 107.25 | 107.25 | 107.25 | 107.25 |
| Net import reliance[5] as a percentage of apparent consumption | 100 | 100 | 100 | 100 | 100 |

**Recycling:** None.

**Import Sources (2002-05):** Monazite: None. Thorium compounds: France, 99.7%; and other, 0.3%.

| Tariff: Item | Number | Normal Trade Relations 12-31-06 |
|---|---|---|
| Thorium ores and concentrates (monazite) | 2612.20.0000 | Free. |
| Thorium compounds | 2844.30.1000 | 5.5% ad val. |

**Depletion Allowance:** Monazite, 23% on thorium content, 15% on rare-earth and yttrium content (Domestic); 14% (Foreign).

**Government Stockpile:** None.

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# THORIUM

**Events, Trends, and Issues:** Domestic mine production of thorium-bearing monazite ceased at the end of 1994 as world demand for ores containing naturally occurring radioactive thorium declined. Imports and existing stocks supplied essentially all thorium consumed in the United States in 2006. Domestic demand for thorium ores, compounds, metals, and alloys has exhibited a long-term declining trend. No thorium consumption was reported in the United States in 2005, according to the U.S. Geological Survey's canvass of mines and processors. In 2006, consumption was believed to be primarily by catalyst manufacturers and was estimated to have increased. On the basis of data through August 2006, the average value of imported thorium compounds increased to $30.28 per kilogram from the 2005 average of $29.35 per kilogram (gross weight). The average value of exported thorium compounds was $456.89 per kilogram based on data through August 2006. The use of thorium in the United States has decreased significantly since the 1980s, when consumption averaged 45 tons per year. Increased costs to monitor and dispose of thorium have caused domestic processors to switch to thorium-free materials. Real and potential costs related to compliance with State and Federal regulations, proper disposal, and monitoring of thorium's radioactivity have limited its commercial value. It is likely that thorium's use will continue to decline unless a low-cost disposal process is developed or new technology, such as a nonproliferative nuclear fuel, creates renewed demand.

**World Refinery Production, Reserves, and Reserve Base:**[6]

| | Refinery production | | Reserves[7] | Reserve base[7] |
|---|---|---|---|---|
| | 2005 | 2006 | | |
| United States | — | — | 160,000 | 300,000 |
| Australia | — | — | 300,000 | 340,000 |
| Brazil | NA | NA | 16,000 | 18,000 |
| Canada | NA | NA | 100,000 | 100,000 |
| India | NA | NA | 290,000 | 300,000 |
| Malaysia | — | — | 4,500 | 4,500 |
| Norway | — | — | 170,000 | 180,000 |
| South Africa | — | — | 35,000 | 39,000 |
| Other countries | NA | NA | 90,000 | 100,000 |
| World total | NA | NA | 1,200,000 | 1,400,000 |

Reserves and reserve base are contained primarily in the rare-earth ore mineral monazite. Without demand for the rare earths, monazite would probably not be recovered for its thorium content. Other ore minerals with higher thorium contents, such as thorite, would be more likely sources if demand significantly increased. No new demand, however, is expected. Reserves exist primarily in recent and ancient placer deposits. Lesser quantities of thorium-bearing monazite reserves occur in vein deposits and carbonatites.

**World Resources:** Thorium resources occur in geologic provinces similar to those that contain reserves. The leading share is contained in placer deposits. Resources of more than 500,000 tons are contained in placer, vein, and carbonatite deposits. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons. Large thorium resources are found in Australia, Brazil, Canada, Greenland (Denmark), India, South Africa, and the United States.

**Substitutes:** Nonradioactive substitutes have been developed for many applications of thorium. Yttrium compounds have replaced thorium compounds in incandescent lamp mantles. A magnesium alloy containing lanthanides, zirconium, and yttrium can substitute for magnesium-thorium alloys in aerospace applications.

[e]Estimated. NA Not available. — Zero.

[1]All domestically consumed thorium was derived from imported materials.

[2]Source: U.S. Department of Defense, Defense Logistics Agency. Based on sales from the National Defense Stockpile.

[3]Source: Rhodia Canada, Inc. and Rhodia Electronics and Catalysis, Inc., f.o.b. port of entry, duty paid, $ThO_2$ basis.

[4]Source: Rhodia Electronics and Catalysis, Inc., 1-950 kilogram quantities, f.o.b. port of entry, duty paid.

[5]Defined as imports – exports + adjustments for Government and industry stock changes.

[6]Estimates, based on thorium contents of rare-earth ores.

[7]See Appendix C for definitions.